# THE RIGHT POWER IN THE RIGHT PLACE

Dental curing lights were invented over 40 years ago, but still present major challenges. For example, most of us understand that we should hold the curing light close to the restoration and keep the light guide clean to allow enough energy to reach the resin. It seems simple, but what about the variables? What about the power density, light dispersion, temperature, the photoinitiators used in the resin, light transmission through the tooth and resin, location and type of restoration, beam angle, distance to the restoration, and position? It's not quite as simple as it originally sounded, though an understanding of key concepts brings everything into focus.

**LED Technology** – In the past, dental curing lights used quartz tungsten halogen bulbs to produce a broad spectrum of light, which was then filtered to allow only blue light from ~380 to 510nm to pass through the filter. These bulbs have a relatively short working life of about 100 hours and both the filter and the reflector degrade over time due to the high heat generated. The advent of blue light emitting diodes (LED) technology, about a decade ago, has revolutionized dental curing lights. LEDs have no "filament" to burn out, but rely instead on special materials deposited on a silicon chip. Many of the first-generation LED chips used for dental curing delivered a low power output and produced only a fraction of the blue light necessary for quality curing results. Since that time, engineers have developed high-powered LED chips, which boast light output that, in some cases, surpasses that of plasma arc curing lights (*New LED Lights Challenge Plasma Arc*, Clinicians Report, March 2009, Volume2, Issue 3). (Christensen, 2009).
**Bottom line:** VALO uses the brightest, most efficient LEDs produced to date.

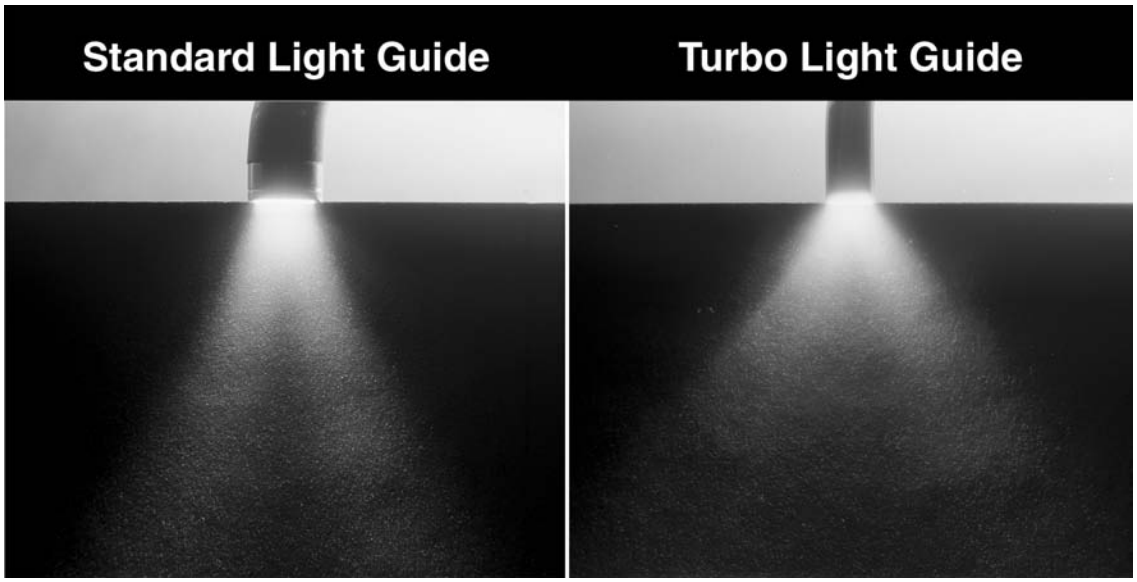
## THE RIGHT POWER

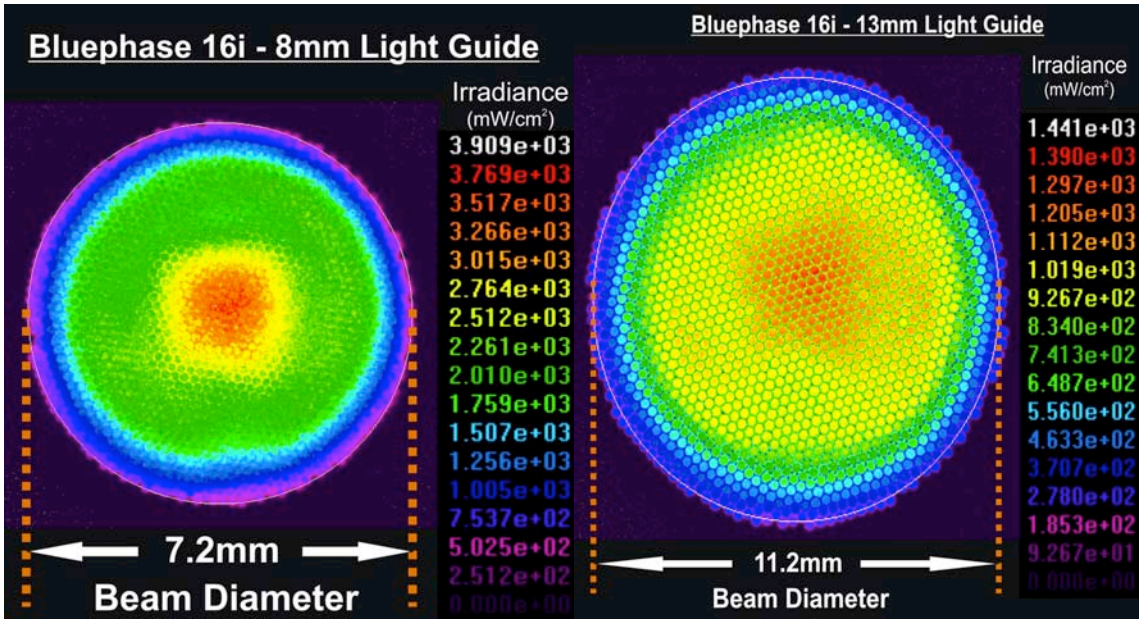
Many terms are used to describe power—irradiance, spectral irradiance, luminance, watts, and Joules—but what is the 'Right Power' to cure dental materials? There is no one single answer, which means that curing light manufacturers need to balance *power density, beam collimation, beam uniformity, spectral distribution, and light transmission through composite* in their designs. Historically, it has been nearly impossible to do this, but the engineers who developed VALO have achieved the best possible results in each area, providing balance without compromise.

**Power density** – Also called irradiance or light intensity, power density is usually expressed as $mW/cm^2$. Most clinicians use power density to compare curing light output, but doing so can be misleading, because although squeezing the same amount of power into a smaller area increases irradiance or density of light, it does not deliver more power, it just focuses power over a smaller area. Most light meters only measure the light output over a small area at the center of

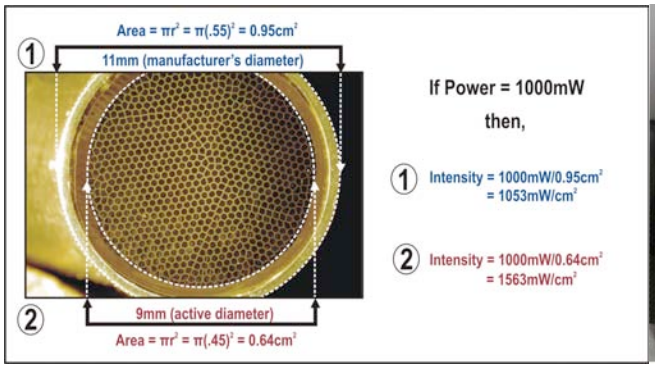
the light beam. This means that lights with a very bright center spot read artificially high and lead to inaccurate representations of brightness and power density. The light also disperses more rapidly as the distance increases from turbo light guides compared to standard light guides

The images below depict the effect of two different light guides on the Bluephase 16i. In the case of the standard light guide, the power was distributed over an active beam diameter of 11.2mm, whereas in the case of the turbo light guide, the same power was distributed over a 7.2mm diameter. Thus, the power density is much greater for the turbo light guide, but it dissipates rapidly with distance.



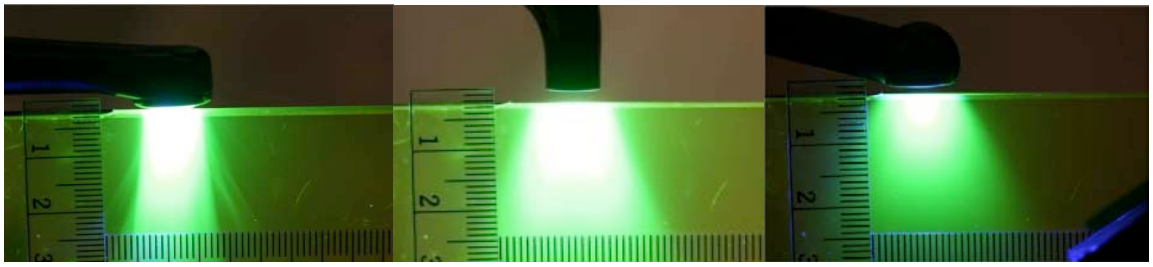

To accurately measure a light's output, a meter must collect all the light produced, and then divide that power by the active light emitting area of the tip.



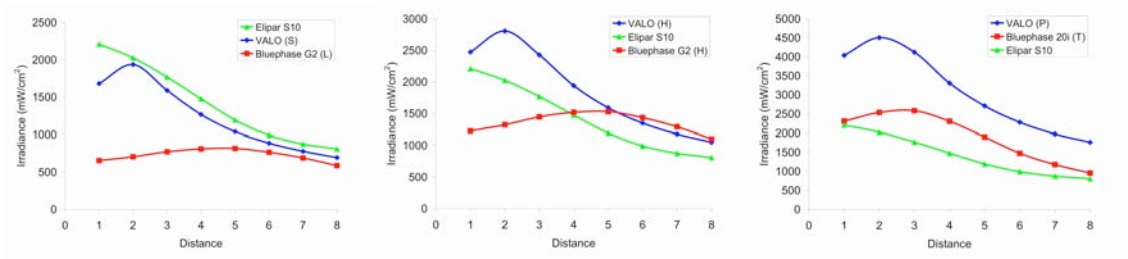


VALO does not use a light guide, and was created with three different power intensity modes to accommodate all curing needs. **Bottom Line:** VALO offers the '**right**' power density for every application.

**Beam collimation** – With all curing lights, the beam disperses when it exits the light guide or tip, resulting in decreased power density with increased distance. With many lights, this power reduction causes inadequate curing, which can lead to microleakage, sensitivity, and restoration failures. With refined optics that create excellent light collimation, VALO maintains intensity over a greater range of distances, allowing the clinician consistent, high quality results at any normal working distance.



*VALO™* *DEMI®* *SmartLite PS®*




*VALO Standard Power:* *VALO High Power:* *VALO Plasma Emulation*

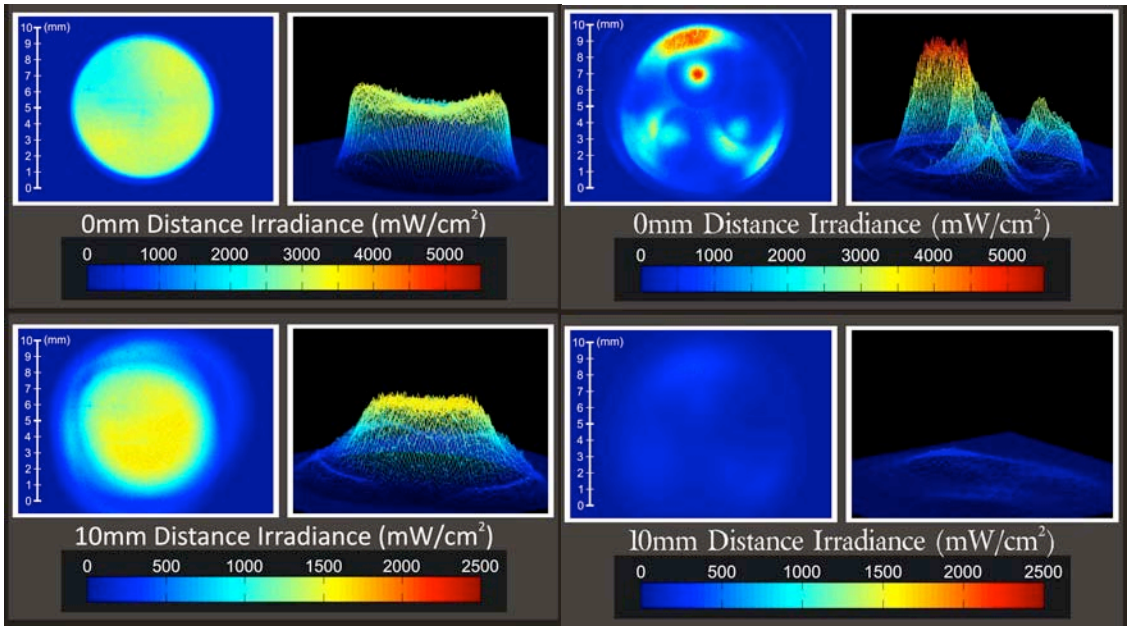
Most curing lights are measured in a laboratory setting at only a few millimeters distance. These lab measurements give artificial representations of curing efficacy, because in reality, most restorations are cured in vivo from up to 10 mm – distances at which the energy, and therefore efficacy, of the curing light can be greatly reduced. To maximize a light's efficacy at normal working distances, the beam must be collimated to allow optimal energy to reach the restoration in all cases.

The table below shows how if a beam diameter increases by only 6mm as the distance from the tip increases, then the irradiance will drop from 1266 mW/cm$^2$ to 498 mW/cm$^2$.

| POWER | Beam DIAMETER | AREA $cm^2$ | IRRADIANCE $mW/cm^2$ |
|---|---|---|---|
| 1000mW | 10mm at the tip | 0.79 | 1266 at the tip |
| 1000mW | 16mm | 2.01 | 498 |

**Bottom line:** VALO has the '**right**' beam collimation to produce quality-curing results at all clinically relevant distances.

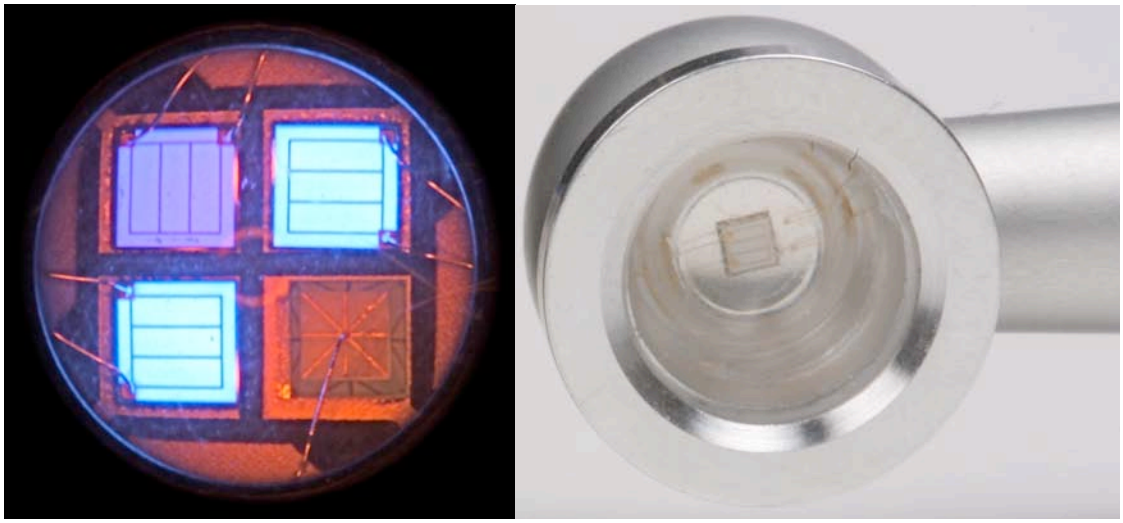
**Beam uniformity** – A curing light's output should be uniform across the curing surface, but many lights vary more than 75% across the curing beam. Non-uniform output causes 'hot' or 'cool' spots, which result in inconsistent curing across the restoration, leading to composite that can be 'softer' in one area and 'harder' in another. VALO solves this problem with specialized optics and LED technology, which produces consistent results regardless of the restoration type, size, or location. **Bottom Line**: VALO offers the '**right**' beam uniformity free of 'hot' and 'cool' spots, enabling it to deliver complete, uniform curing.



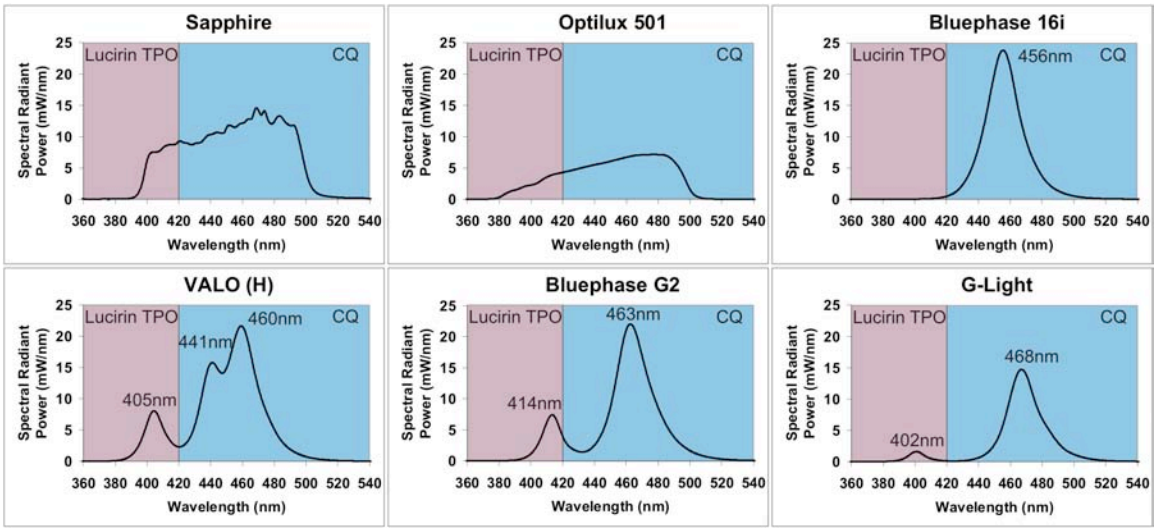

*VALO™ Beam Profile* *FLASHlite Magna® Beam Profile*

**Spectral distribution** – This refers to the specific wavelengths or colors of the light delivered, e.g. 370-510 nm. Curing light manufacturers like to tout these figures, and rightfully so; if a curing light does not emit light over a broad spectrum, some dental materials will not polymerize completely. Quartz halogen bulbs produced the necessary ranges of blue and violet (spectral irradiance) to cure all dental materials. The advent of LED technology created a problem in that LEDs produce only a narrow spectrum of blue color, and are unable to adequately cure the many dental products containing proprietary initiators. A true broad-spectrum curing light needs to produce light in the right color ranges—where the photoinitiators are most sensitive—to thoroughly cure dental materials. With its custom LED chipset, VALO produces light that provides uniform curing throughout the restoration, as well as three peak wavelengths or colors of blue and

violet (an industry first), allowing it to cure all dental materials effectively. **Bottom line:** VALO features the **'right'** spectral irradiance or wavelengths to cure all dental materials.

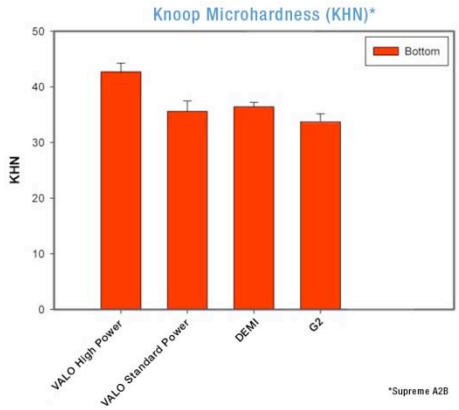


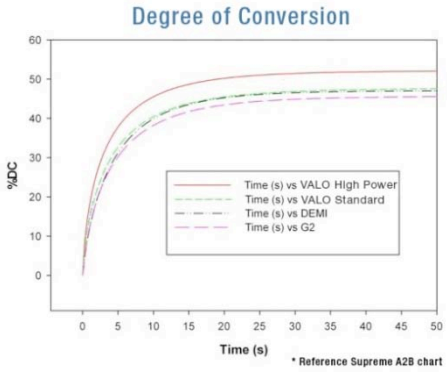
*VALO's Custom LED Chipset* *Competitor's LED Chipset*




*Spectral Distribution of VALO™ and Competitors' Curing Lights*

**Light transmission through composite** – When light hits composite, its reaction depends on the composite's hue, refractive properties, filler type, volume, and translucency/opacity. For a restoration to be cured completely, light must penetrate deep into the composite to produce a uniform cure from top to bottom; poor light transmission increases the likelihood that a restoration will fail. While VALO cannot control variations in composite, it can compensate for these variations through its appropriate selection of wavelengths (colors) and power distribution. The light VALO produces adheres to the amounts of energy recommended by dental composite manufacturers, and penetrates standard layers of composite to achieve a maximum cure.
**Bottom Line:** With the **'right'** wavelengths to penetrate composite, VALO offers a greater degree of conversion.




## THE RIGHT PLACE

Even if a curing light has the 'Right Power,' what happens when that power cannot get to the 'Right Place?' Several factors affect proper curing light position, including: *light guide design, beam angle, location and restoration type, distance between the restoration and the light guide, and ability to stabilize the curing light during the procedure.*

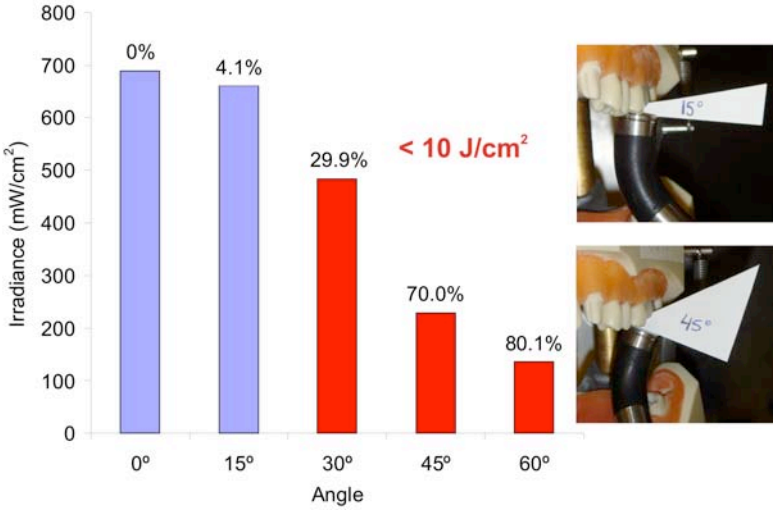
**Light guide design** – The average adult male mouth opens 43mm at the incisors (Gallagher et al, 2004) with a maximum of 55mm from incisal edge to incisal edge (*Mouth Opening Among Nigerians*, Chima Oji, Department of Oral & Maxillofacial Surgery – College of Medicine, University of Nigeria, Enugu Campus – Enugu, Nigeria). (College of Medicine, University of Nigeria, Enugu Campus, 1995). This distance drops to 30mm when working in vivo (*Mouth Opening*, Anesthesiology, V 99, No 4, October 2003). (Calder et al, 2003). That doesn't leave much room to work, especially in the posterior region. Curing light manufacturers know this, but still design gun-style or modified gun-style curing lights with bulky light guides or heads. Most of these use glass fiber optic light guides that can produce significant power density problems. They become even more problematic if they feature the usual 45° angle bend, which makes it difficult to get the light perpendicular to the restoration surface. These designs make it nearly impossible to properly position the light for adequate curing, as patients simply cannot open their mouths wide enough. Most of these problems occur when curing posterior restorations, though many lights are unable to achieve appropriate curing position even in anterior regions. VALO does not use a light guide, and its wand-style design offers the practitioner access to what would otherwise be inaccessible. VALO allows the clinician to properly position the curing light in all areas of the mouth, without discomfort to the patient. **Bottom Line:** VALO has the 'right' design to ensure proper light placement.

*Mouth Opening (Pediatric) with VALO™*

*Mouth Opening (Pediatric) with DEMI®*

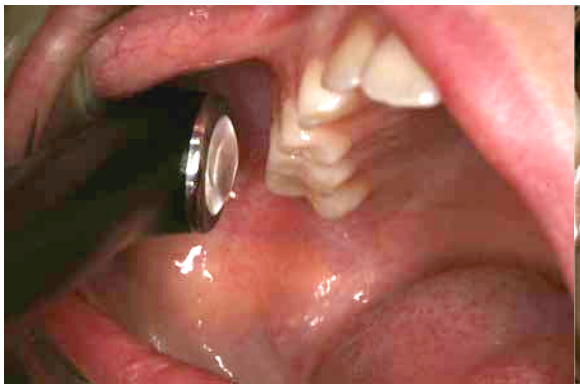
**Beam angle** – Light guides with the standard 45° angle inherently increase beam angle and distance, producing light that strikes the restoration at an angle. When that angle exceeds 30°, a

great deal of light energy reflects off the surface and is not absorbed into the restoration. This results in a critical loss of energy, making effective curing impossible. In difficult to reach restorations, the incident angle is increased, further reducing power density and curing efficacy, and increasing the possibility of restoration failure. VALO's wand-style design, along with the 5° angle of its head, enables the practitioner to position the tip directly over the restoration site with a 0° beam angle. **Bottom line:** VALO has the '**right**' beam angle to allow optimal curing in any location.




*Effects of Angulation on Irradiance Values*

**Location and restoration type** – The locations of many in vivo restorations make proper curing light positioning almost impossible, especially when using a curing light with an oversized head or the traditional "angled" light guide. Poor curing light design leads to patient discomfort, practitioner frustration, and under-cured restorations, especially when working in the posterior region of the mouth, as in the case of a distal buccal on a second molar. VALO's low profile design enables proper placement, even for children or patients with limited opening capability. **Bottom line:** VALO has the '**right**' head design to access hard-to-reach areas.



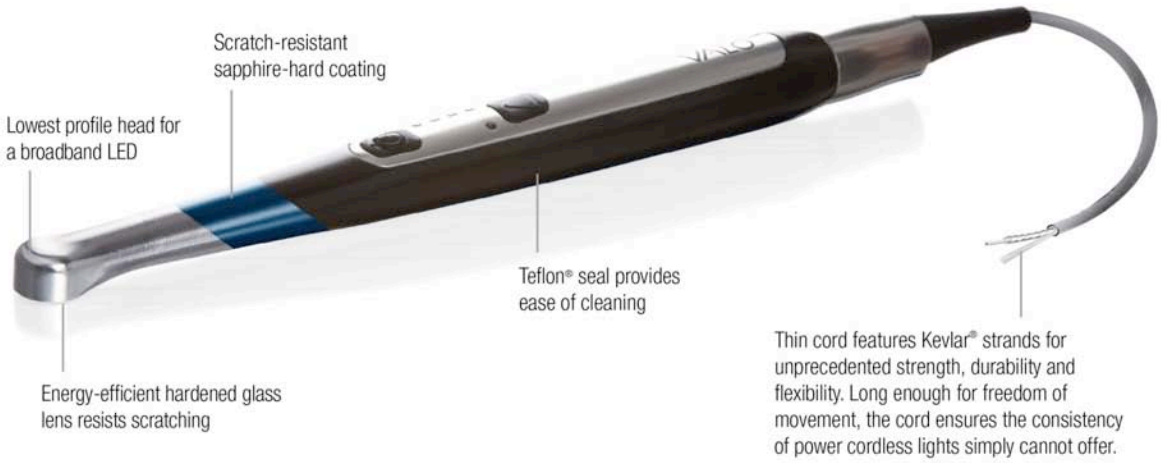
*Intraoral Access with VALO™*

*Intraoral Access with DEMI®*

**Distance between the restoration and the light guide** – It is easy to maintain a specific distance from the restoration site in a laboratory setting. Mount a curing light to a lab bench, put the tip directly over the dental material, and adjust it to the desired distance. It's not so easy in vivo, where curing distances can vary from 0 to an estimated 10 mm+. As the tip gets farther away from the restoration site, the power density drops significantly. Further difficulties ensue when you cannot center the light over the restoration. Moving the light even a few millimeters off

center can greatly reduce the curing efficacy of most lights, which increases the potential for microleakage, sensitivity, and toxicity. **Bottom line:** With its low profile shape, wand-style design, and ergonomically correct construction, VALO significantly reduces the possibility that the practitioner will experience distance and offset issues.

**Construction** – Crafted from a single piece of aircraft aluminum, VALO is the most durable (drop tested) curing light available. Its scratch-resistant, sapphire-hard coat can be easily cleaned, and with few seams or crevices, VALO is unlikely to capture dirt and debris. VALO's custom LED chip is not overpowered, unlike other LED curing lights on the market, and will therefore maintain its brightness for life. Powered by a thin, flexible cord (rather than batteries, which power most LED curing lights), VALO eliminates concerns about battery life and the cost of replacements. The fact that it does not use batteries also affords VALO a sleek, durable, ergonomic body. **Bottom line:** VALO, the most durable and effective curing light ever built, is the **'right'** curing light for years of trouble-free service.




**THE TRUE BOTTOM LINE:** According to the JADA, over 37% of all composite restorations are insufficiently cured. (Fan et al, 2002). Are yours? VALO – **The Right Power in the Right Place**.

Give yourself the best opportunity for successful cures. Choose VALO for your practice.

VALO®

ULTRADENT'S NEW LED CURING LIGHT

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